https://dx.doi.org/10.22161/ijreh.3.4.2 *ISSN: 2456-8678*

An Emergent *Carapa oreophila* Products Value Chain – A Case Study of the Kilum Mountain Forest Communities, Cameroon

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Abstract— *This study focused on the tradable products of Carapa oreophila and employs ethno botanic quantitative methods. Semi-structured ethno botanical questionnaires were conducted to collect information on general knowledge of Carapa oreophila, characteristics of informants; plant parts exploited as well as gathering; processing and storage methods. The reasons for use: market value, points of sales, means of transport, trade channels, constraints and their opinion on resource availability. Ethno botanic method and descriptive statistic were employed to measure the effect of product exploitation. This paper exposes three traded Carapa oreophila products with high market value. Fuel wood and leave-rodent chain had high market value and high turnovers while wood craft goods, hoe and axe handles had high turnovers but low market value. Leave harvesters are also fuelwood suppliers. The incomes earned by harvesters of the Carapa products are used to meet their domestic demand for money or liquidity preference. Unfortunately, harvest methods and techniques are unhealthy and do not contribute to secure the forest resource. Given its multipurpose uses, we recommend the promotion and enhancement of Carapa oreophila through its domestication and seed oil production to provide significant socio-economic benefits to the local people. To this end, it is necessary to implement strategies to support local communities to actively participate in the conservation and sustainable use of the species as part of the preservation of plant biodiversity.*

Keywords— Carapa oreophila, harvesters, consumer, craft wood, fuel wood, value chain.

I. BACKGROUND

Value chain is an economic concept that was introduced in the universe of forest natural resources, in order to increase our understanding of the importance of non-timber forest products (NTFPs). NTFPs unlike other natural forest resources is believed by many scholars to be a resource which can both improve livelihood by reducing poverty and create jobs along its distribution channel while preserving its generational capacities from the host forest resource site [1]. A report from the GCP/RAF/408/EC Forests for Poverty Reduction project reveals that, about 570 plants and 110 animal species in Cameroon are used as NTFPs. The estimated market value of the 45 main NTFPs traded in Cameroon, including bush-meat, fish, fuelwood and plant-derived products, is worth around US$1.028 billion annually. At least 283,000 people in Cameroon and 70,000 people in the Democratic Republic of Congo (DRC) are involved in businesses based on 15 major NTFPs, thus the total number for the whole sector is much larger [1] (Awono*et al*., 2013). This represents more than twice of formally recorded employment in the forest sector both in Cameroon and DRC.

The sum of NTFPs traded in most developing countries come from open access community forest where neither harvest regulations nor sound governance practices exist (Ingram *et al*., 2010). Compounded with the absence of knowledge on good harvesting practices and the rural's abject poverty, some NTFPs' host species survival becomes endangered. This is why [2] echoed that the livelihoods of those involved in NTFP enterprises can be considered sustainable when they can cope with and recover from stresses and shocks, and when living standards and assets can be maintained or even enhanced, both now and in the future, while not undermining the natural resource base that communities depend upon.

https://dx.doi.org/10.22161/ijreh.3.4.2 *ISSN: 2456-8678*

Literature on Cameroon's NTFPs value chain, its socio-economic and environmental impacts has witnessed a sharp growth at the turn of the century both within academic theses and scholarly published papers with pioneers scholars like [3][4][5][6] [7]. From the total of over fifty-nine plant species whose NTFPs have been studied and strategies for sustainable management proposed, *Carapa oreophila* has received the attention of few scholars who were interested only on the ecology and ethnobotanical uses of a diversity of medicinal plants. A few of these studies stated some uses of *Carapa oreophila* in Lebialem and Fundong[8] [9]. None of these scholars in Kilum mountain forest area were interested in the *Carapa oreophila* products value chain.

This paper aims at assessing *Carapa oreophilas* products; identify those with high market value and thus trace its market chain in order to propose improved sustainable management and conservation of the species.

II. MATERIALS AND METHODS

Study site

The Kilum Mountain forest is found in Oku, South West of Bui division in the Western plateau in the North West Region of the Bamenda Highland ranges. The area is located between Latitudes 4° East and 6° 5' North of the equator. It host the second highest mountain in the Western highlands of the country at an altitude of 3011 m, this volcanic structure spreads 26 km between the rift valley of Djottin in the North, the plain of Ndop in the South on 8 km between longitude 10° 28' and 10°36' East .

The vegetation of the area is mainly composed of woodland, wooded grassland, grassland, shrubland and gallery forest above 2400 to 2500 meters. The Kilum–Ijin forest from its origin had a surface area of 20,000ha [10] and the most significant remnant of Afromontane forest in West Africa. Deforestation has increased in the area over the last two decades, as the rapidly growing population has combined with declining economic conditions and decreasing soil fertility to increase the demand for new farmland.

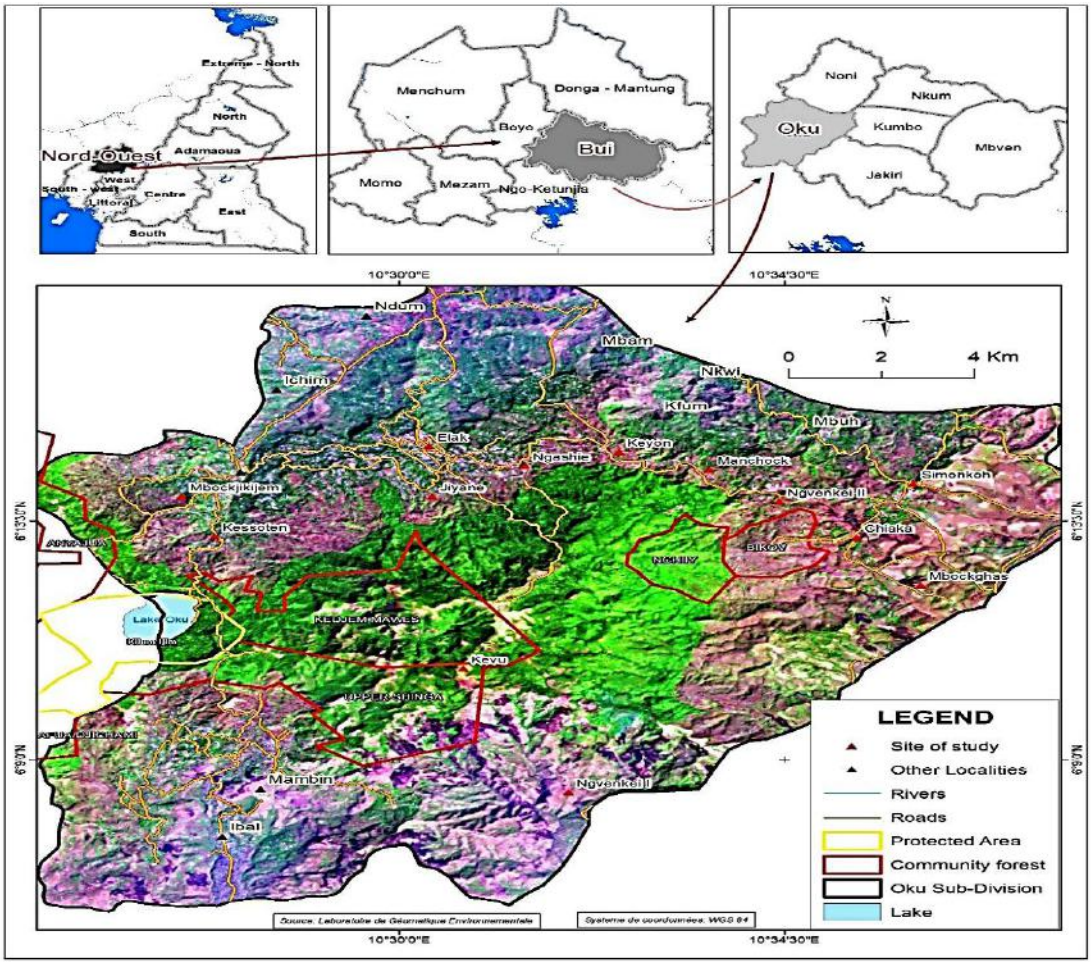

Fig.1: Presentation of the study area

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Studied species

Carapa is a tropical angiosperm plant (family of Meliaceae), found in theCentral North and South America and in Africa [11]. The genus was recognized since 1775 with 27 species names and *C. oreophila*is the only species found in the Kilum community forest [12][13]. The dominant and most exploited is *C. oreophila* which has suffered pressure from human settlement, extensive cultivation, overgrazing and fires. This species is the focus of our study.

Some assessments on the vegetation of Kilum were established by [14] [15], on inventory of tree population present in the forest classifying species population into dominant tree types for each altitudinal level. In their methodology they divided the mountain into six stages based on altitude. In each altitudinal stage the sample area was 1ha divided into 25 sample plots of 20 m by 20 m each.

Surveys

Data collection was performed with the aid of a semi structured questionnaires as described and used in [6] on 726 informants distributed in the twelve communities and chosen using snow-ball method. Moreover, focused-group discussions (of five persons per meeting) were carried out with key informants chosen in collaboration with village leaders. The choice of these localities was based on the presence of a natural forest and local use of *Carapa oreophila* by local communities.

Preceding the survey, a meeting held with Oku Fon and his advisors at the Fondom's palace inform them of the purpose of this work. Informants were chosen randomly among those who have knowledge about *Carapa oreophila*. All informant and participant in focused-group discussion were informed of the objective of the study in order to get their consent. The contact and address of those who agreed were recorded in a survey logbook after the first interview for subsequent interviews.

The informations collected during these investigations focused on general knowledge of *Carapa oreophila,* characteristics of the informants; the plant parts exploited, gathering; processing and storage methods for the products, reasons for use: market value, points of sales, means of transport, trade channels, constraints and their opinion on resource availability. Discussions with street rodent retailers in Kumbo, Bambungo, Bamenda, Mbouda and Bamougum high way junctions were held in order to assess the final sale price to consumers far away from Kilum.

A pair of scale and measurement tape was employed to get the net weight of leaves used to tie a bundle of processed rodent. The net weight was obtained by subtracting the net weight of the processed meat from the gross weight of the bundle. The experiment was repeated on ten different bundles to get an average weight to work with. Similarly, an average number of leaves necessary to form a bundle was determine, besides the breadth of the leaves, the diameter of storms of trees or harvested trunk and branches were measured and recorded. This information was useful to assess the effect of exploitation of *Carapa* products on the host forest.

Data analysis

Descriptive statistics and Stata 14 were employed for data analysis. Kruskal-Wallis equality-of-populations rank test was performed to check the significance of differences in responses. Excel was used to plot some graphs of descriptive statistics.

III. RESULTS

Local names

The etymologies of the vernacular expressions reveal the historic cultural attachment of the people to the plant. In Cameroon, the Oku people call the tree 'ebvin', while the Nso as 'Kijwun' [16][17]. These local names echo the ability of the plant to catch fire and burn even in fresh or wet state after direct harvest from the forest and the suitability of the wood for carving crafts. The trunk and wood is differentiated from its bloody red colour.

Identified Products of Carapa oreophila in the study area

Table 03 reveals all the plant parts harvested. Meanwhile just two are directly commercialized as fuelwood or as carved items after transformation in workshops. The carved items are farm tool handles (axe and hoes specially), carved chairs, carved poles, figurines and staff. The third plant part – the leaf – is commercialized as a joint-supply product as wrapping for processed rodents, locally known as "Oku sardine" a protein delicacy for the people of Kilum.

Three value chain products were thus identified: fuelwood chain; wood craft chain and leaf-rodent chain (Table 01). Unfortunately, there seems to be no regulation specifically classifying rodents among wildlife in the list of NTFPs [5]. Had it come to existence by now, we are sure that the local community has not yet been appraised with its substance. That is why this unique combination of plant and animal NTFP value chain is studied under the label: Leave chain.

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Table.1: Screening Carapa oreophila Products with high market tradable value

Carapa oreophila Plant parts and uses		
Plant parts	Purpose for use	Tradability
Trunk/ logs	Fuel wood; carvings	Commercialized
Branches	Fuel wood; carvings	Commercialized
Bark	Medicinal	Not commercialized
Roots	Medicinal	Not commercialized
Fruits & seeds	Medicinal	Not commercialized
Leaf	Wrapping & medicinal	Joint supplied with processed rodents
Gum	Glue for mending leakages	Not commercialized

Table.2:Product with a market chain

Value chain	NTFPs	Form of use	Reasons of use
Fuel wood chain	Trunk; branches	Whole trunk; whole branches; split trunk; split branches	heating, energy, cooking
Wood craft chain	Trunk; branches	Whole trunk; whole branches;	Hoe handles; axe handles; staffs, Carved poles, benches, chairs & furniture
Leaf chain	Leaves	Whole leaf joint-supplied with rodents	Bush-meat fast food known as "Oku sardine"

Harvesting, gathering and collection of tradable *Carapa oreophila* products

The fuelwood and Wood craft chains. The sap wood is pink, heartwood pinkish or redish when freshly harvested. Wood derived products employ several harvest methods in the extraction and exploitation of *C. oreophila* wood (Fig. 02a). We have assessed the felling method; the peeling or debarking; picking method and pruning. Moreover, 17.1% employ more than one method for harvesting. Kruskal-Wallis equality-of-populations rank test reveals a significant difference at p=0.001 between males and females ($\chi 2$ = 89.989), between fuelwoodproducers and craftsmen ($\chi 2$ = 89.039) and between levels of education of harvester ($\chi 2$ = 156.578). In terms of state of harvest, 39.0% harvest both fresh and dry, 37.1% dry wood, and 29.9% only the fresh (Fig. 02b). The Kruskal-Wallis equality-of-populations rank test ($\chi 2$ = 157.257) is significant at p=0.0001.

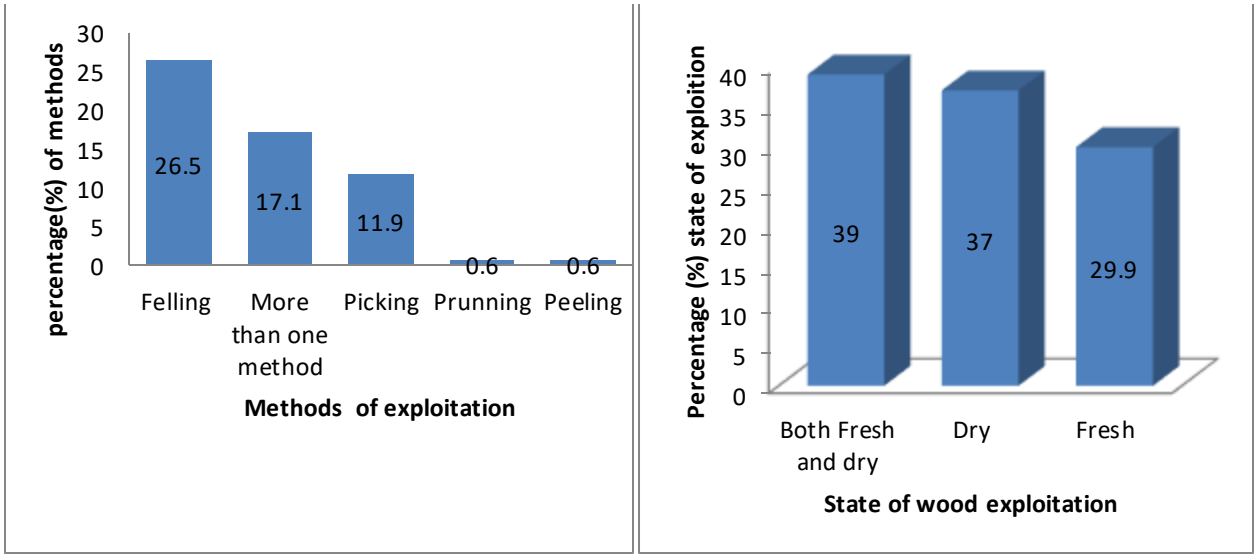

Fig.2: a) Methods of wood extraction *b) State of harvest of wood*

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Furthermore, both fuel wood producers and crafts men have identical harvesting tools which are cutlasses or machetes, axe or both tools. There is significant difference of harvest tools used between fuelwood producers and craftsmen on the one hand, and between their levels of education on the other hand at p=0.0001 for a Kruskal-Wallis equality-of-populations rank test of $\chi 2$ = 32.653 and 150.065 respectively. However, additional tools are employed by craftsmen to transform the raw product to craft wood. These tools are: hammers of varied size and weight; chisels of varied sizes; specialized blades; files for sharpening; sand papers for smoothing; brushes; vanishes and a few modern electric tools. The level of technology is still rudimental.

The peak for fuelwood exploitation is in the dry season and rarely in the rainy season. Unlike craft wood, there is no peak period of harvest as the demand for craftworks is slow but steady. This difference in peak period between fuelwood producers and craftsmen is significant at p=0.0004 for Kwallis $\chi 2$ test with ties = 18.342. Conversely, the frequency of harvest depends on the craftsman's experience which is influenced by both his/her longevity of craftsmanship and age of the actors. Longevity is significantly (p=0.0001) different with respect to levels of education (Kwallis $\chi 2$ test with ties = 111.572). Besides, in terms of frequency of forest visits by harvesters, 29 % exploit wood on daily bases, 10.6 % twice per day, 6.1 % thrice per week and 4.8 % exploit once in two weeks (Kwallis $\chi 2$ test with ties = 25.526, p=0.0001).

For fuelwood, tradable bundles of 55.5kg are transported on head (53.9 %), two wheel truck (1.9%) or motorbikes (1.0%). Besides transporting bundles of fuelwood to be sold, they carry alongside prized logs, trunk and branches to their workshops. However, some objects like drums, chairs of large size had been de-fleshed (or pre-carved) before transportation in order to reduce transportation weight. Craftworks are stored in chest (special figurines and masks) for safe transportation to sales venue, where they are kept lying and removed to be place in show case. Means of transportation is significantly (p=0.0006 and 0.0001 resp.) different both fuel wood producers and craftsmen and with respect to levels of education (Kwallis $\chi 2$ test with ties = 17.477 and 137.325 resp.).

Farm tool handles from craftsmen are stored in dry area in home or in market shops, while wood are stored in opened or closed shades, on veranda or stacked against the wall and plastic batches or old sheets of zinc are used for additional protection during rainy season. Eight spots have been identified as sale point for wood: (1) open air or at the road side; (2) at home; (3) supply to stall owners; (4) supply to soya vendors; (5) to restaurants; (6) neighbouring villages; (7) blacksmith and (8) supply to local bakeries. These sales points are used by exploiters, retail-traders and other middlemen to evacuate either raw forest output (un-split logs or large split fuel wood) direct from forest or semi-finish or finish product (split fuel wood ready for use). Unlike fuelwood, craftworks have five sales points: (1) craft-showrooms and touristic centres; (2) local markets; (3) at home and/or the craft-shops; (4) to middle-men away from the community and (5) open air and provision stores. Farm tool handles are advertised by hanging the tools on windows; roof beams and ropes. The sale venue is significantly different (p=0.0001) both for fuelwood producers and craftsmen and with respect to levels of education (Kwallis $\chi 2$ test with ties = 65.161 and 129.891 resp.).

Of all craftworks, the demand for farm tool handles is alleged to be high. The price of a farm tool handles range from 300-500 FCFA; axe handles 700-1000 FCFA, decoration poles, 10000-15000 FCFA just to name a few. The price of wood in the sample area is related to the spatial location of the exploiter. This is explained by their accessibility to the roadside junction and those in the interior with prices ranging from 500 to 1500 FCFA. A bundle of wood weighs on average 55.5Kg. According to results and focus group discussion 239.760 tons of wood are supplied to(5) local bakeries and 85.248 tons to (4) Restaurants and (4) Soya vendors each, giving a total of 410.256 tons/annual for a cost of 7,392,000 FCFA at the price of 1000 FCFA per bundle of 55.5 kg. Table 03 represents the evolution of fuel wood prices between 2010 and 2017. Fuelwood prices were high as 1200, 1000, 1500 FCFA, in Elak, Manchock and Kivu respectively. Givingin generaly a price mean of 1233.3 FCFA per 55.5 kg of wood.

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Table.3: Evolution of fuelwood prices between 2010 and 2017

	Cost (Price /bundle in FCFA)							
	Year							
Location	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Keyon	600	700	800	800	1000	1000	1000	1000
Ngashie	600	700	800	800	1000	1000	1000	1000
Bongkighas	500	500	500	500	500	500	500	500
Ngvenikei 1	600	700	700	700	1000	1000	1000	1000
Kesoten	700	700	800	800	1000	1000	1000	1000
Kivu	500	500	600	600	600	700	1000	1000/1200
Mbojekejem	500	500	600	600	600	1000	1000	1000
Nguvinkei 11	700	700	700	700	700	700	1000	1000
Jiyane	400	400	600	600	700	700	700	700
Manchock	700	800	1000	1000	1000	1000	1000	1000/1500
Chaika	500	500	500	700	700	700	800	800
Elak	800	800	1000	1000	1000	1000	1000	1000/1200

The leaves' chain – a joint-supply product: Hands are used to plug leafs and this is done as often as rodents are available to be processed. The frequency of harvest depends on the frequency of hunting; as a result more leafs are harvested as more rodents are caught. Responses reveal that 15.5% trap rodents on daily basis, 7.7% weekly and 5.8% less often. The rate of rodents catches is significantly (p=0.0001) different with respect to levels of education (Kwallis $\chi 2$ test with ties = 57.010). Rodents are caught with the fruits of *C. oreophila* used as bait on cables, wires and other local material used as trap. According to focus group discussion and informat respondents, 6.8%, admitted that the peak for rodents is usually during the rainy season when several rats are trapped. The peak period for rodent catch is significantly (p=0.0001) different with respect to levels of education (Kwallis $\chi 2$ test with ties = 58.458).

The transportation of leaves is observed in two fronts. First stage is its going out of the forest. The leaves are arranged by aligning, placing one on the other. Then they are folded and fasten with a cord obtained from the forest. They are then parked in the bag. For few quantities, the leaves are parked directly in the bag. The means of transportation to the house available is by motorbike or on foot. At home, the rodents are process and parcelled using leaves as wrappings. The second stage of transportation of leaves corresponds to the transportation of processed rodents to the market as joint goods. Hence, the marketing of rodent is taken as proxy to leaves for leaves exploitation. The processed rodents are packed in bags transport on motorbike; truck; car; or on foot to market places where they are bought and moved to homes and culinary factories using similar means of transport. Means of transportation is significantly different (p=0.0001) both for fuelwood producers and craftsmen and with respect to levels of education (Kwallis $\chi 2$ test with ties = 65.161 and 129.891 resp.).

The processed rodents enveloped in *C. oreophila* leaves are stored in refrigerators and cool rooms in homes and culinary factories. For poor households on dryers above fireplaces or in covered dishes away from unwelcomed home carnivores. The meat is conserved or enveloped with the leaves. Rodents processing for commercialization put the product in packets or bundles fasten with a cord obtained from the forest [18][19]. The quantity of leaves necessary to envelop a packet vary from 8 to 10 leaves (average fresh leaves weight 3.35g) dependent on the sizes of the animals and number decided upon to form a bundle.

According to a trapper, processing starts by cleansing which involves cutting the tail and the legs from the body, emptying the bowels, then roasting to remove the hair. *C. oreophila* leaves are then used to packet the body's in bundles of 8 bigger rats or 10 smaller rats. The bundles are heated in smouldering charcoal for a few hours and are ready for sale afterwards.

Table 04 below exposes the volume of leaves jointly supplied with traded rodents by the community and the income earn by middle men and harvesters, besides it shows the value of expenditure on process rodents accounted to local consumers in the community.

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Table.4: Hunting chain in the kilum area

	EXTRACTED LEAVES FOR HUNTING CATCHES TRANFORMATION		INCOME FLOW		
	Estimated quantity of bundles	Estimated quantity of leaves	Rodent dealer's annual gross income	Rodent Retailer's annual net income	Rodent Consumer's annual expenditure
Stratified villages	Q'ty/annum	Kg/annum	F xaf	F xaf	F xaf
Manchock	960	2.88	940800	534000	346800
Elak	912	2.736	902400	366000	291600
Chiaka	1344	4.032	1344000	0	156000
Sub total	3216	9.648	3187200	900000	794400
Nguvenkei 11	576	1.728	576000	54000	162000
Mbockinghas	528	1.584	369600	108000	72000
Ngashe	1296	3.888	1296000	0	108000
Sub total	2400	7.2	2241600	162000	342000
Keyon	336	1.008	336000	0	72000
Mbockjikijem	528	1.584	528000	78000	90000
Nguvenkei 1	288	0.864	288000	72000	72000
Sub total	1152	3.456	1152000	150000	234000
Jayane	240	0.72	240000	0	78000
Kesotin	336	1.008	336000	180000	54000
Kevu	0	0	0	60000	72000
Sub total	576	1.728	576000	240000	204000
Grand total	7344	22.032	7156800	2904000	1574400

Actors

The actors were grouped per product value chain exploited (Fig. 3a). Within the fuelwood 25% are harvesters, i.e. those who extract fuelwood from the forest; 3.12% are middlemen and 14.9% are fuelwood consumers. In the wood craft chain, 16% are wood harvesters who combines fuelwood and craft but rather prefer to be known as craftsmen, 2% middlemen who deal on handicraft items and 12.8% consumers of any handicraft object. Finally, in the leave-wrapping value chain, 12.8% harvest leaves and hunt rodents, 2.9% are middlemen who are engaged in processed rodent trade as a principal or secondary activity and 9.8% are processed rodent consumers. This distribution of *C. oreophila's* actors is significantly ($p=0.0001$) different with respect to the tradable *Carapa* products (Kwallis $\chi 2$ test with ties = 70.273). Moreover, 53% of the harvesters are assisted in harvesting NTFPs from the forest by their children, 24% by their brother or relatives and 22% a friend (Fig. 3b). This distribution of house-help to actors is significantly ($p=0.0227$) different with respect to the tradable Products (Kwallis $\chi 2$ test with ties = 9.564). Furthermore, the consumers are made of households of varied profession; businesses in the service sector; agro-processing industries; small-scale industries; travellers and tourists.

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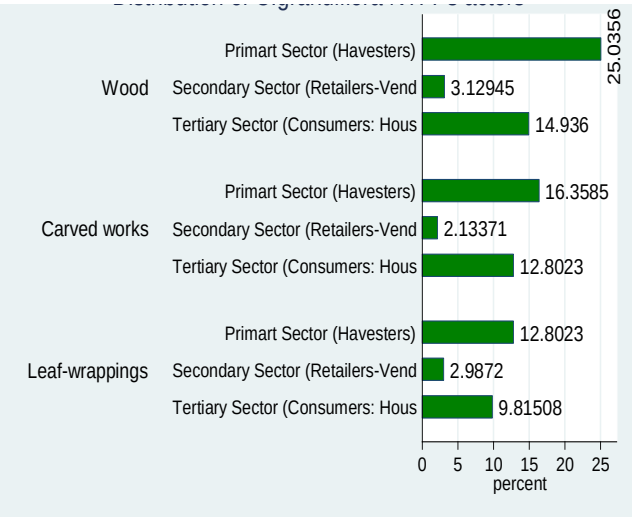
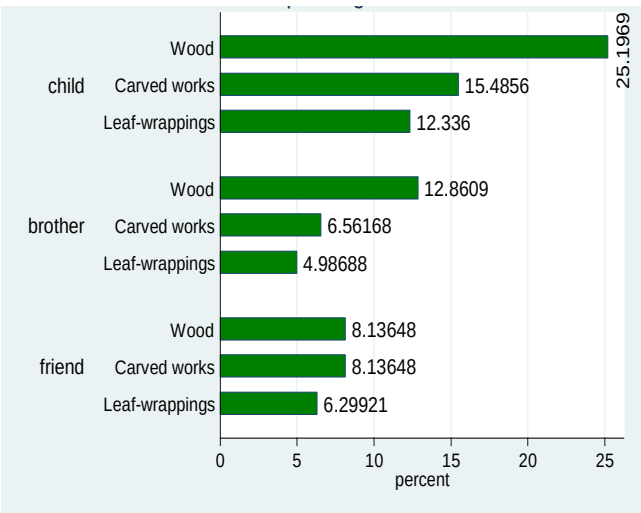


Fig. 3: a) Distribution of actors per value chain



b) House help to NTFPs harvesters

With respect to regulations, 40%; 29%; 24% respectively from among fuelwood harvesters, principal wood craftsmen and leave- rodent producers acknowledged the existence of regulation governing the extraction of forest product and opine that they are good enough to follow in order to preserve to some extend the forest. The opinion on both the existence of the law and its intent is not significantly (p= 0.7721) different both for the *Carapa* harvesters perception of its existence and with respect to their judgement on the intent of law per value chain actor (Kwallis $\chi 2$ test with ties = 0.517). However, of those mentioned above, 30% from among fuelwood harvester; 21% among the principal wood craftsmen and 17% leave- rodent producers deplore the shrilled absence of law enforcement officers. The opinion on the existence of law enforcement officers is not significantly (p= 0.806 and 0.0001 resp.) different for both NTFPs harvesters perception of its existence and with respect to their judgement on the intent of law per value chain actor (Kwallis $\chi 2$ test with ties = 0.6683).

Value chain map

Figure 4 provide the value chain map of the three (03) commercialized *C. oreophila*products.

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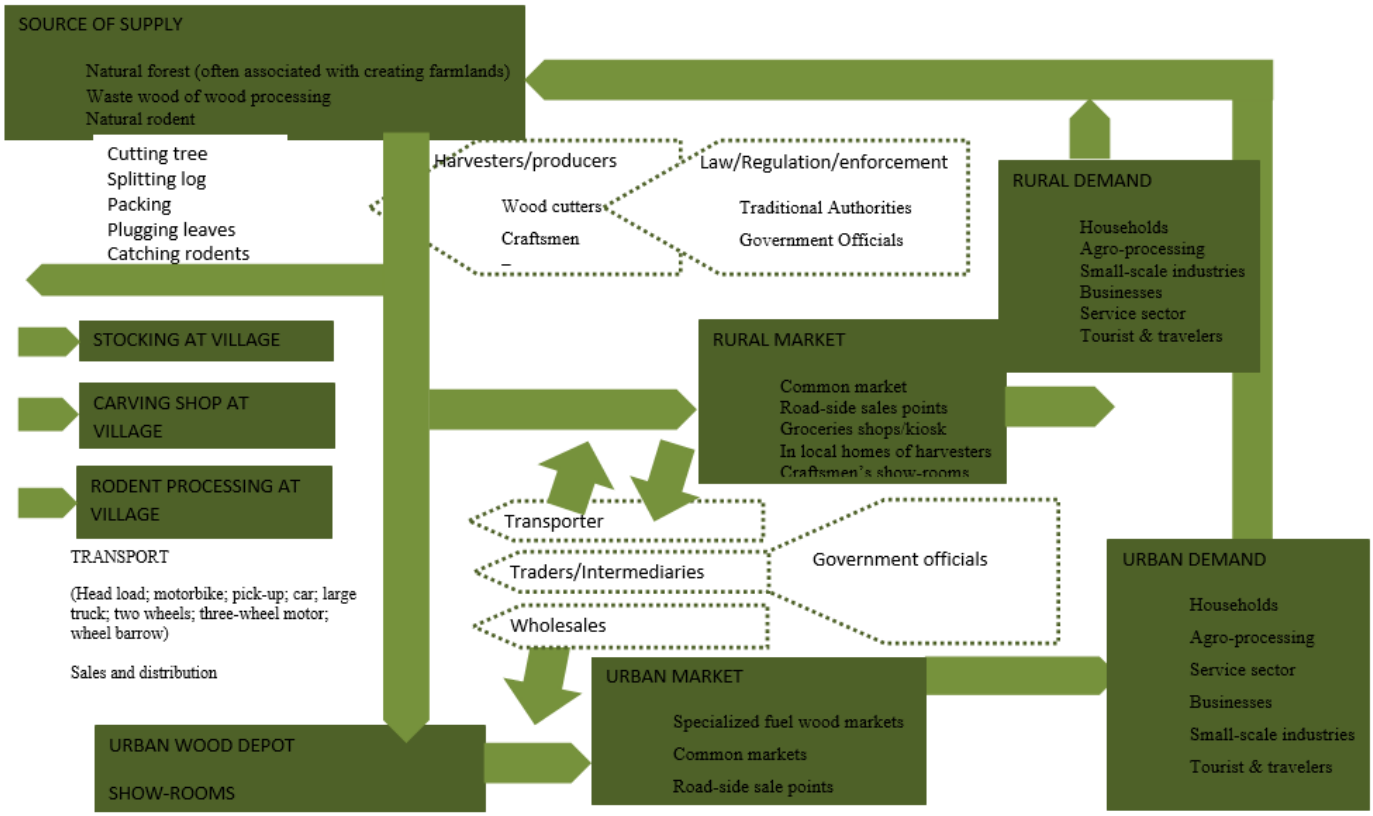

Fig. 4: Carapa oreophila products value chain and main actors involved. Adapted from [20]

Market channels

As shown in fig 4, over 75% of fuelwood that is bought from the local market by middlemen is transported to the various Bamenda fuelwood markets and to the Ndop basin where they are used to smoke fish. Most often, middlemen arrange for transportation to carry the load in immediately accessible packing or storage areas at the edge of the forest. 22% of the fuelwood is sold on the rural market and 3% often consumed by the harvester's household. Carved objects are commercialized after some processing. Hoe-handles; axe-handles are the products with high turnover alongside wooden kitchen tools. They take shorter production cycle and cost, which makes them very profitable. 70% of these carved products bought by middlemen move to towns of the West, North and South West Regions. According to focus group discussion, some middlemen carry their load to neighbouring towns of Kumbo. 30% of the farm tools handles are sold in the rural market. Carved items with low turnover generally have long production cycle. They are thus subject to special order. Carved poles are sold for used within a limited socio-cultural geographical space, figurines, chairs, benches and staffs are bought for personal use by wealthy local elites and the rest is bought by middlemen or transported by the craftsman to show-rooms in large cities and overseas. By-passing tourists are also interested in figurine which they buy 70% of processed rodent is smuggled to by middlemen where they end-up in restaurants and beer parlours. 30% is sold in the local rural market. Middlemen initiate and control the channels and act as liaisons with local producers.

IV. DISCUSSION

This study gets from Kilum community knowledge that, of all useful known plant part of *Carapaoreophila*, three (03) are tradable: fuelwood; wood crafts and leave for wrapping rodents. While the first two elements have direct market value, the last element has an indirect value because it is passed on as an accessory joint-supply good. In effect, it is the processed rodent – animal-based NTFP – that has got market value.

Rodent trappers, who are not involved in processing, sell a number of rodents necessary to make up a bundle at 800 FCFA or 1000 FCFA. Those specialized in processing then

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do the preparations, package them with the leaves and supply a bundle at 1500 FCFA or 2.7272 € (i.e. 7.81% price share). Middlemen smuggle the bundle to large cities where they either reduced a bundle of 8 rodents into 4 rodents and sell for 1000 FCFA– 1500FCFA giving retailers (i.e. 33.85% price share for a bundle of 8 rats), while retailers with little or no adjustment in the packet rather sale above 1500 FCFA up to 2000 FCFA. Discussions with street retailers in Bamenda, Mbouda, Dschang, Bafoussam motor parks; and Balessing high way junctions revealed that the demand is high from November to March when increase of rural tourist is provoke by burials and funerals ceremonies.

Craftsmen produce goods of both high and low turnover. Farm tool handles (hoe and axe handles) have high turnover. They are sold at 300 FCFA or 0.5454 € (37.5% price share) in the local market. Middlemen buy and sell them in neighboring rural towns of Kumbo, Babesse, Bamenda, Foumban, Mbouda and Wum at 500 FCFA or 0.9090 € (25% price share) to retailer and shop owners who in turn sell it at 800 FCFA or 1.4545 € (37.5% price share). Tambourines, drums, and carved (decorated) poles are produced on order, whereas figurines and carved chairs produced and part expose in show-rooms near workshops and the rest supplied to cooperative groups who channels them to museums in and out of the national territory. These categories of craftsmen's goods have high market value but low turnover. A bundle of fuelwood with a weights of 55kgs is sold at 1400 FCFA or 2.5454 € at most (i.e 25.45% price share). Middlemen buy and supply the bundle at 2500 FCFA or 4.5454 € to retailers in towns (20% price share), who then splits and reduce the height of the wood or the bundle to form smaller bundles of fuelwood of 1kg to sell at 100 FCFA or at 10.00 € for the initial bundle (i.e. 54.55% price share).

The differences observed in harvester income per value chain product ranks in terms of market value with fuelwood ranking first followed by craft wood and leave-rodent last. These results are statistically significant at p= 0.0976. Kruskal-Wallis equality-of-populations rank test for method used versus tools, χ^2 with ties = 4.655 with 2 d.f. The results corroborates with those of [21] who studied the income of fuelwood harvesters and processed rodent producers in Kilum-Ijim forest. The income thus earned is used to solve routine needs of high priority like school fees, dresses for the household, household's modern furniture and sound equipment, android smart phones, television set, food items, payment of eletricity and heath bills. The modes of transportation revealed in the study were similar to that of [22] who noted that the main transportation mode of wood to Garoua town was mainly on head 69.4%, truck 8.1%, bicycles, 9.5% and only 1.7% for motor bykes.

Unfortunately, with the absence of enforced regulation in such free community forest, overexploitation and unhealthy harvest practice set in an effort to compete for income. While catch of rodents threatens its population, leaves harvesting techniques does not lead to the death of the tree; it participates to the sustainable management of the plant in the forest [23]. Like leave plugging, picking and pruning methods are sustainable, but not all the wood necessary for the market could be supplied with these methods. Felling then becomes unavoidable, but three things were observed on the field. First, the height at which the trunk is cut does not allow the storm to shoot sprouts for regeneration. Second, trunks of all diameters are used and as a result there is no minimum diameter that is prohibited.

A single harvester may reserve more than he can harvest in a year, thus putting harvester who come after him to move further away into the forest to reserve or harvest due to the monatery value attached to this spacious tree species in the Kilum community forest as observed by [24]for Njansangproduct in the South West Region of Cameroon. The benefits of NTFP in the Kilum forest community has been observed elsewhere in Cameroon [5][25].

Informant's responses indicate that for those who live nearby the forest 20% have to wonder over a distance of at least 1 km into the forest and 60% beyond a km distance, while those who live far away from the forest limits have to cover the extra distance between their individual homes and the forest. Of these groups, 10% have reported to wonder in the forest over a distance beyond 1.5km to reach out a tree to harvest. The distance covered in the forest express the scarcity of the species which is significantly (p=0.0001) different both for fuelwood producers and craftsmen and with respect to residence nearness to forest (Kwallis χ^2 test with ties = 23.162 and 611.724 resp.).

V. CONCLUSION

This paper has exposed three traded *Carapa oreophila* NTFPs with high market value. Both fuelwood and leave-rodent chain have high market value and high turnover. Of wood craft goods, hoe and axe handles have got high turnover and low market value. The remaining wood craft goods have very high market value but low turnover. This has made craftsmen to participate as harvesters in the fuelwood chain. Leave harvester are also fuelwood

https://dx.doi.org/10.22161/ijreh.3.4.2 *ISSN: 2456-8678*

suppliers. The incomes earned by harvesters of the NTFPs are used to meet their demand for money or liquidity preference. Unfortunately, harvest methods and techniques are unhealthy and do not contribute to secure the forest resource.

Similar to *Carapaprocera*, the multipurpose uses and products of *Carapaoreophila,* are unrecognized amongst the population of Cameroon because of the limited geographical span of the local knowledge. Commercial use of its seed's oil in relation to the market values of the known traded NTFPs; its value in farming; cosmetic and pharmaceutical industries are unknown to the Kilum community. Sad to say that despite this handful of advantages presented by the plant, the harvest sizes and techniques of this open community forest resource threaten its disappearance and the impact is already felt by the population.

For the immediate future, we recommend the promotion and enhancement of *Carapa oreophila* through domestication and seed oil production to provide significant socio-economic benefits to local people. To this end, it is necessary to implement strategies to support local communities to actively participate in the conservation and sustainable use of the species as part of the preservation of plant biodiversity.

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